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DRINKING WATER SOURCE PROTECTION PLAN

Canyonlands National Park

March 2001

WATER RESOURCES DIVISION

National Park Service - Department of the Interior
Fort Collins - Denver - Washington

DRINKING WATER SOURCE PROTECTION PLAN

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WATER RESOURCES DIVISION

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EXECUTIVE SUMMARY

The Needles area of Canyonlands National Park is the only area of the Park having a public water supply source. Water for public use in the Maze area is hauled from Moab. Water for public consumption at Island in the Sky is hauled from Arches National Park.

Potable water for the Needles area is supplied from a shallow well near Cave Spring. Various other shallow wells in this general area have been the water source in the past. The wells have obtained water from the alluvial sands or the upper part of the Cedar Mesa Sandstone Member of the Cutler Formation in the Squaw Canyon Creek and Salt Creek drainages. Saline groundwater is encountered in wells drilled deeper than 200 feet.

Available information does not allow us to delineate the area of groundwater flow to the well for various travel times, as prescribed by Utah Division of Drinking Water. Hydrologic data is inadequate to determine even the direction of groundwater flow, although it is generally believed that groundwater flow is northwesterly, toward the Colorado River. Therefore, we used the optional two-mile radius for developing this drinking water source protection plan.

There are few potential contaminants in the area. There are no potential contaminant sources in the area that are not under the direct control of the National Park Service.

The following procedures are recommended to reduce the potential for contamination of the ground-water resource and drinking water supply at the Needles area of Canyonlands National Park.

1. Continue periodic monitoring of water quality at monitor wells adjacent to the abandoned landfill.
2. Continue leak detection monitoring at the diesel fuel and gasoline storage tanks.

3. Provide secondary containment for all fuel, oil, and solvent containers.
4. Continue periodic inspection of areas where paint, solvents, etc. are stored in the maintenance area.
5. Purchase paint, solvents, etc. on an as-needed basis to reduce quantities stored on site.
6. Plug and abandon all unused wells in the Needles area. This probably includes Well Nos. 3A, 3B, 4, 5 and 6. Piezometers and monitor wells associated with these wells should also be plugged and abandoned.

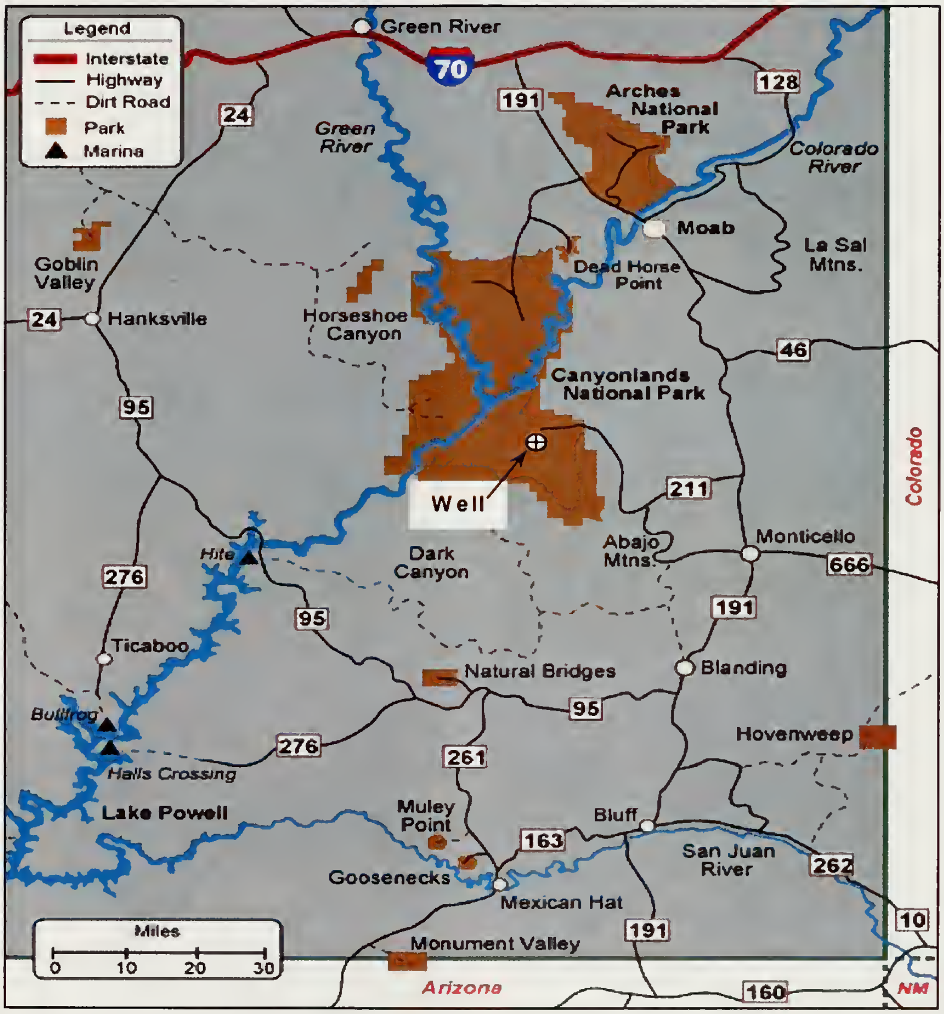
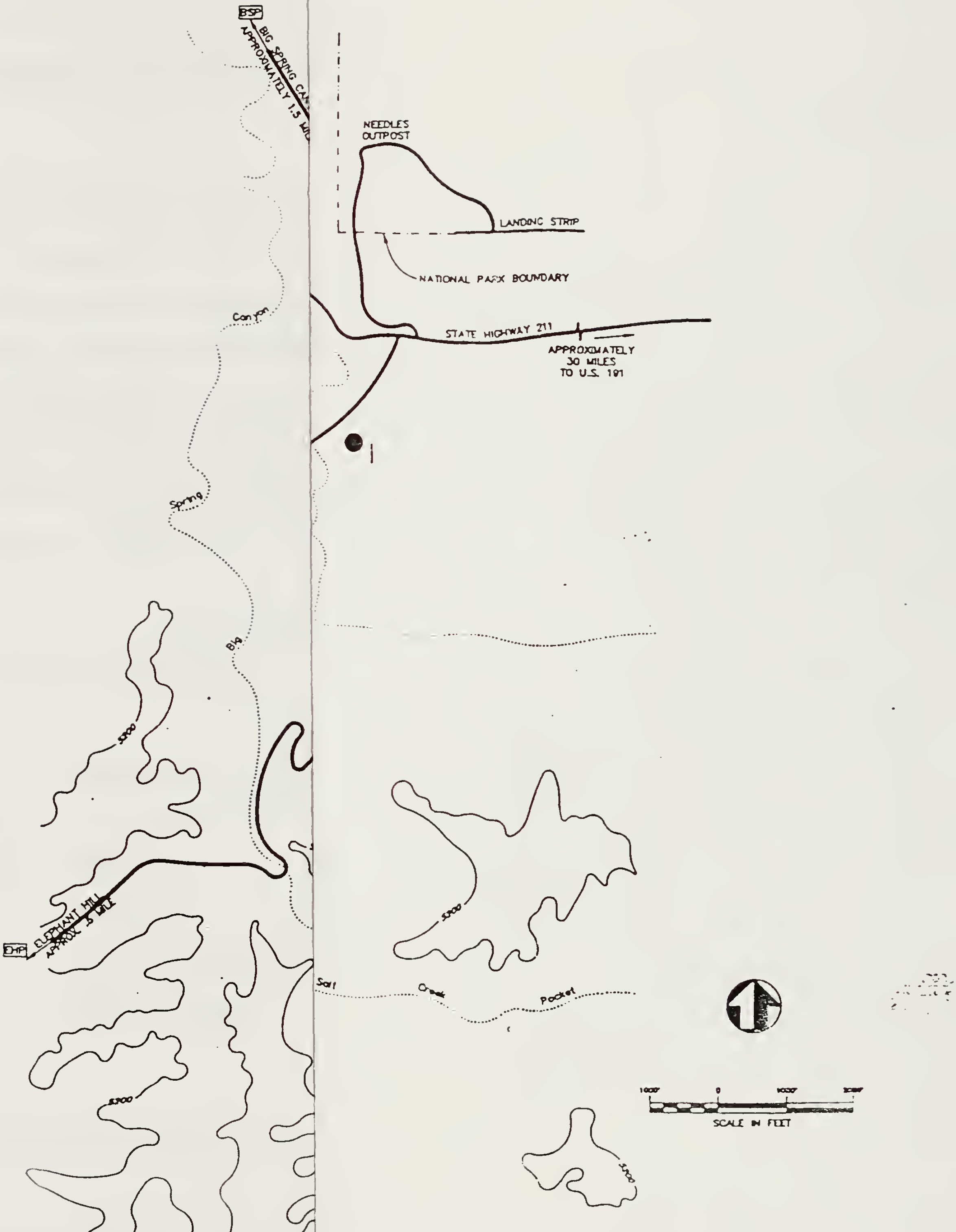


Figure 1. General Location Map



DESIGNED: EJC DRAWN: SLW TECH. REVIEW: EJC DATE: 05/20/92	SUB SHEET NO. CP-1	TITLE OF SHEET CANYONLANDS NATIONAL PARK NEEDLES DISTRICT COMPREHENSIVE PLAN	DRAWING NO. 164 41,030A PKG. NO. 203 B&C SHEET 3 OF 136

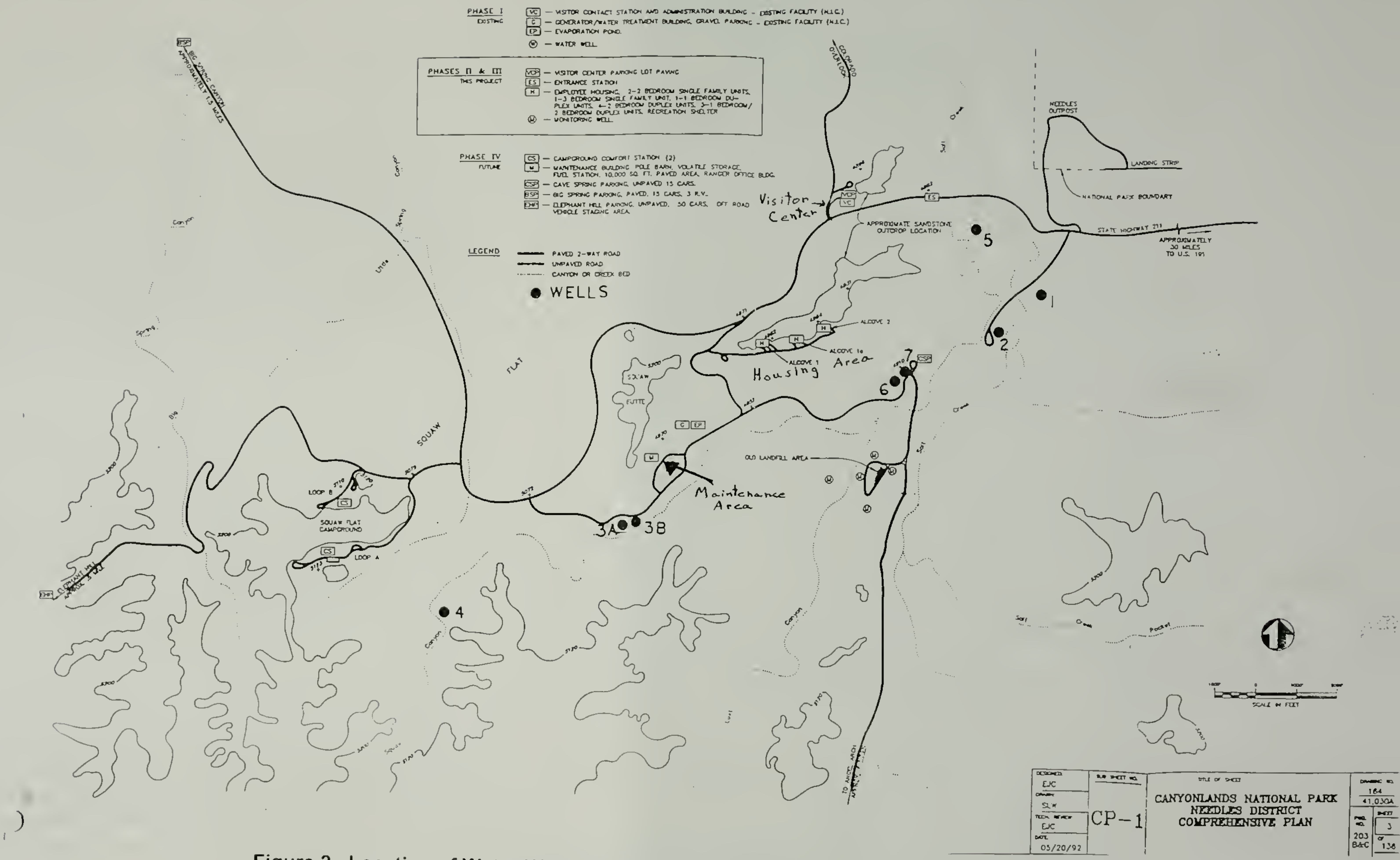

PHASE I
EXISTING
VC — VISITOR CONTACT STATION AND ADMINISTRATION BUILDING - EXISTING FACILITY (N.I.C.)
C — GENERATOR/WATER TREATMENT BUILDING, GRAVEL PARKING - EXISTING FACILITY (N.I.C.)
EP — EVAPORATION POND.
W — WATER WELL
PHASES II & III
THIS PROJECT
VCP — VISITOR CENTER PARKING LOT PAVING
ES — ENTRANCE STATION
H — EMPLOYEE HOUSING, 2-2 BEDROOM SINGLE FAMILY UNITS, 1-3 BEDROOM SINGLE FAMILY UNIT, 1-1 BEDROOM DUPLEX UNITS, 4-2 BEDROOM DUPLEX UNITS, 3-1 BEDROOM/2 BEDROOM DUPLEX UNITS, RECREATION SHELTER
M — MONITORING WELL
PHASE IV
FUTURE
CS — CAMPGROUND COMFORT STATION (2)
M — MAINTENANCE BUILDING, POLE BARN, VOLATILE STORAGE, FUEL STATION, 10,000 SQ. FT. PAVED AREA, RANGER OFFICE BLDG.
CSP — CAVE SPRING PARKING, UNPAVED 15 CARS.
BSP — BIG SPRING PARKING, PAVED, 15 CARS, 3 R.V.
EHP — ELEPHANT HILL PARKING, UNPAVED, 50 CARS, OFF ROAD VEHICLE STAGING AREA
LEGEND
PAVED 2-WAY ROAD
UNPAVED ROAD
CANYON OR CREEK BED
● WELLS
BIG SPRING CANYON APPROXIMATELY 1.5 MILES
COLORADO OVERLOOK
Visitor Center
NEEDLES OUTPOST
LANDING STRIP
NATIONAL PARK BOUNDARY
STATE HIGHWAY 211
APPROXIMATELY 30 MILES TO U.S. 191
APPROXIMATE SANDSTONE OUTCROP LOCATION
ALCOVE 1
ALCOVE 1a
ALCOVE 2
Housing Area
Maintenance Area
OLD LANDFILL AREA
SQUAW FLAT
SQUAW BUTTE
SQUAW FLAT CAMPGROUND
LOOP A
LOOP B
ELEPHANT HILL APPROX. 3 MI
Little Spring Canyon
Big Spring Canyon
Salt Creek
Squaw Canyon
Lost Canyon
Salt Creek Pocket
TO JASPER CANYON
1
2
3A
3B
4
5
6
7
SCALE IN FEET
DESIGNED EJC
DRAWN SLW
TECH. REVIEW EJC
DATE 05/20/92
SUB SHEET NO.
CP-1
TITLE OF SHEET
CANYONLANDS NATIONAL PARK
NEEDLES DISTRICT
COMPREHENSIVE PLAN
DRAWING NO. 164 41,030A
PKG. NO. 203 B&C
SHEET 3 OF 136

Figure 2. Location of Water Wells and Developed Areas

The legal description of the well location is; SE¼ of SE¼ of SW¼, Section 20, T30S, R20E SLBM.

Water is used for drinking and restroom facilities by park visitors at the Visitor Center and Squaw Flat Campground. Water from this system is also used by park staff at administrative and maintenance buildings. There are 19 employee residences at Needles, including single-family and multiple unit dwellings. Water use ranges from about 1.0 – 1.5 million gallons per year. In winter months, when visitation is low, demand is about 50,000 gallons per month. In summer months, when visitation increases, water demand is about 150,000 gallons per month. Water use at Needles for 1992-98 is shown in Figure 3.

1.3 Designated Person - R309-113-5:

Owner:	National Park Service	
Superintendent:	Jerry Banta	Phone: (435)-719-2100
Facility Manager	Mike Hunter	Phone: (435)-719-2150
Operator:	Don Tyree	Phone: (435)-259-8859
Address:	2822 South West Resource Blvd. Moab, UT 84532	

2.0 THE DELINEATION REPORT - R309-113-9 (5)

The primary sources of hydrogeologic information for this report are unpublished reports, memos, and other documents in the files of the National Park Service Water Resources Division in Ft. Collins, Colorado. Two published reports, Sumison and Bolke (1972) and Richter (1980), describe the hydrogeology of the area in a regional context.

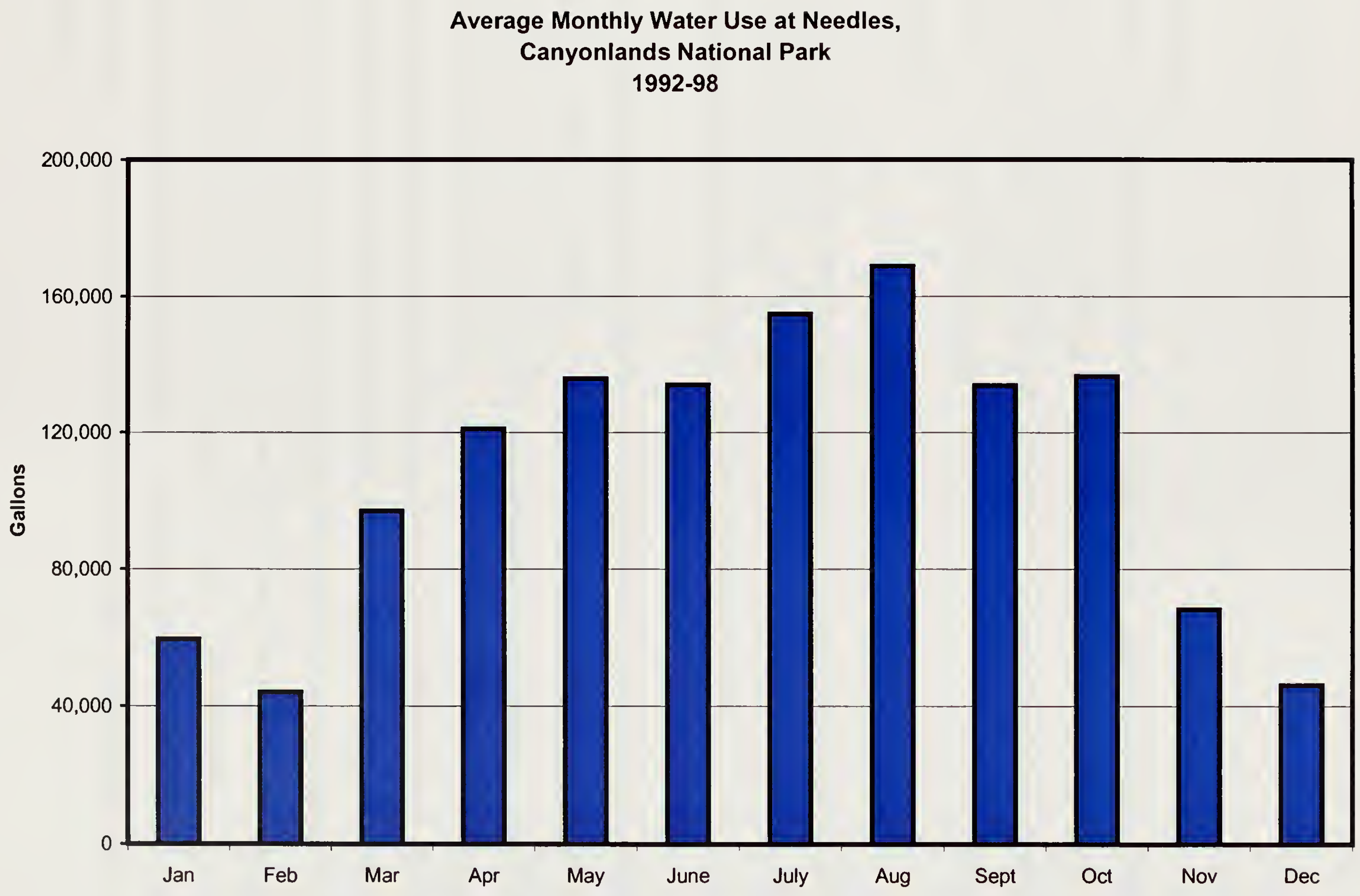


Figure 3. Water Use at Needles, Canyonlands National Park

There are no water supply wells within several miles of the site, other than those constructed by the National Park Service to supply developments in the Needles area.

2.1 Geologic Data - R309-113-9 (5)(a)(i)

Hydrogeology

The only two aquifers of concern in this area are the Quaternary Alluvium and the Cedar Mesa Sandstone Member of the Cutler Formation. Deeper geologic formations contain saline water. Only one well in the area has been drilled deeper than 80 feet (Well No. 1). It encountered saline water and was immediately plugged and abandoned.

Quaternary Alluvium is the shallowest aquifer in the area, occurring in association with Squaw Canyon Creek and Salt Creek. The general lithology of these aquifers is characterized as sand, gravel and silt, with good water quality.

The Cedar Mesa Sandstone Member of the Cutler Formation is the predominant geologic formation outcropping in the area. It is composed of massive, cross-bedded sandstones and forms dissected plateaus and escarpment slopes. The thickness of the Cedar Mesa Sandstone varies from 200 to 1200 feet. The primary permeability of the Cedar Mesa Sandstone is along fractures, joints, and bedding planes. Richter (1980) and Huntoon (1979) indicate intergranular permeability in the Cedar Mesa Sandstone. However, the retention of water in potholes for sustained periods following precipitation events indicates that intergranular permeability is very likely low (Ecosystems Research Institute, 1984a). Numerous springs and seeps have been identified as flowing from outcrops of the Cedar Mesa Sandstone. As observed by Richter (1980), most of these springs occur in association with faults, joints, and partings in bedding planes of the sandstone.

Water Quality

Water quality data for Well No. 7 are summarized in Table 1. Samples collected from Well No. 7 in 1990, at the time of the original well construction, were analyzed for a suite of volatile organic compounds, but none were found above detection limits. In general, the water quality is suitable for potable uses. Water is passed through a green-sand filter to reduce iron and manganese concentrations. Water is chlorinated and stored in three 20,000-gallon underground tanks and distributed to all National Park Service facilities in the Needles area.

2.2 Well Construction Data - R309-113-9 (5)(a)(ii) & (iii)

During 1965, the National Park Service drilled four wells in the Needles area. Well No. 1 was located east of Salt Creek in an area where a silty or very-fine sand facies of the Cedar Mesa Sandstone Member failed to yield much water. Drilling continued into the underlying Rico Formation, which yielded saline water. The well was plugged and abandoned. Well Nos. 2, 3, and 4 were successfully completed in alluvium and the upper part of the Cedar Mesa Sandstone Member of the Cutler Formation. In 1968, Canyonlands Needles Outpost constructed Well No. 5 on National Park Service land near the confluence of Squaw Canyon Creek and Salt Creek. In 1971, Well No. 3B was drilled 55 feet from Well No. 3. Subsequently Well No. 3 became known as Well No. 3A. In 1988, two (1" PVC) observation wells were constructed near Well No. 2 and four (1" PVC) observation wells were constructed near Well Nos. 3A and 3B to facilitate testing of the aquifer and wells. Also in 1988, a test well (Well No. 6) and observation wells were constructed at Cave Springs. In 1990, Well No. 7 was constructed at Cave Springs.

Table 2 contains a summary of construction information for wells in the Needles area. Well locations are shown on Figure 4.

Table 1. General water quality, Well No. 7

Date	11/13/90	8/28/95	10/18/93	
pH	7.5			
Turbidity, NTU	1.1	1.5		
Spec. Cond. (umhos)	---	565		
Hardness ($CaCO_3$)	235	240		
TDS (mg/l)	505	326		
Ca (mg/l)	66	55		
Mg (mg/l)	18			
Na (mg/l)	48			
K (mg/l)	1.8			
HCO_3 (mg/l)	226			
SO_4 (mg/l)	89	54	46	
Cl (mg/l)	35	33		
NO_3 (mg/l)	0.143	<0.02		
Fluoride (mg/l)	0.30			
Arsenic (mg/l)	0.006	<0.005		
Barium (mg/l)	0.15			
Boron (mg/l)	<0.001			
Cadmium (mg/l)	<0.0002	<0.001		
Chromium (mg/l)	0.001			
Copper (mg/l)	0.008			
Iron (mg/l)	0.62	0.54		
Lead (mg/l)	<0.001			
Manganese (mg/l)	0.019	0.04		
Mercury (mg/l)	<0.00005	<0.0002		
Silver (mg/l)	0.0002			
Selenium (mg/l)	<0.001	<0.001		
Zinc (mg/l)	0.014			

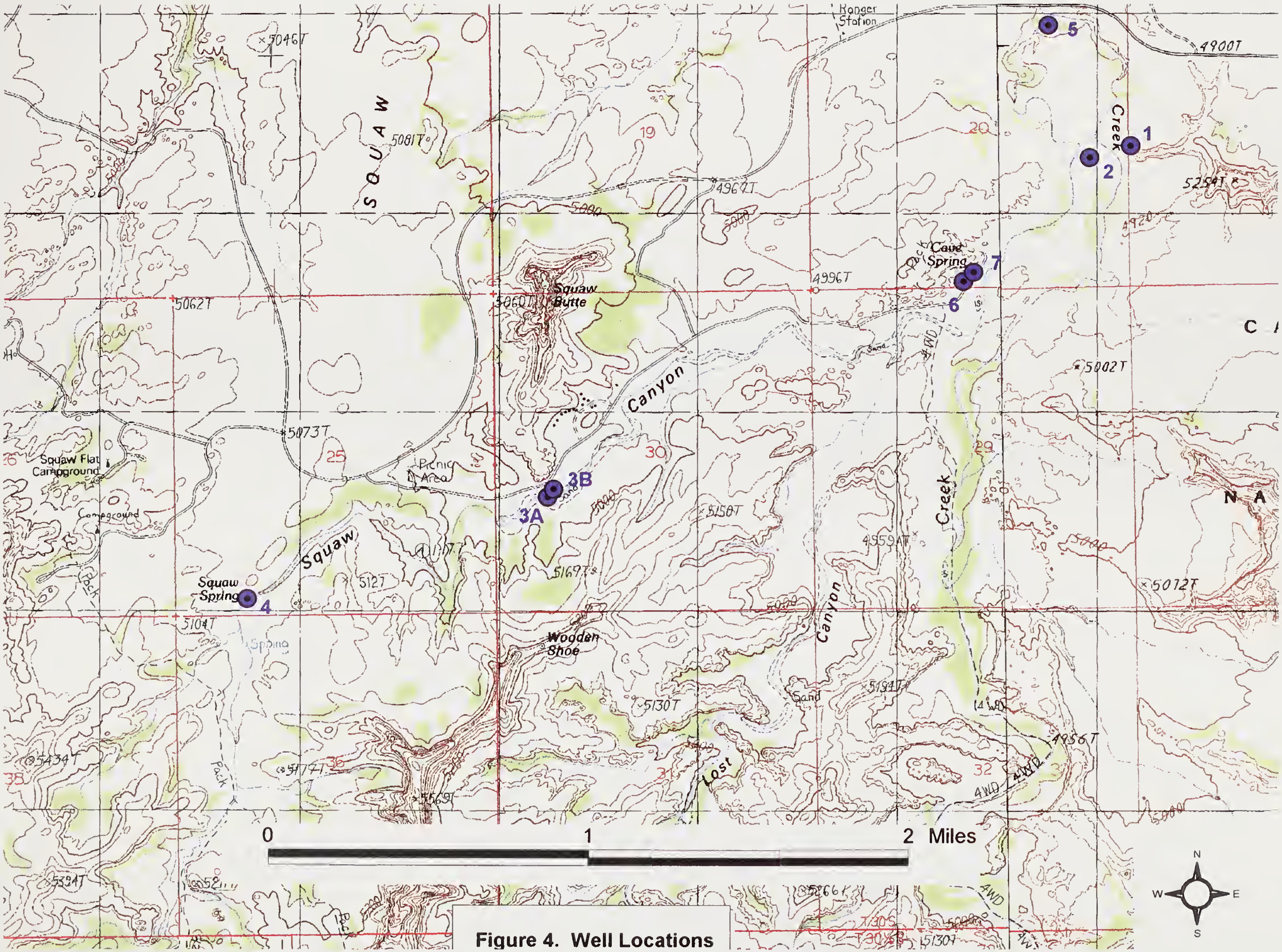


Figure 4. Well Locations

Table 2. Summary of well construction in Needles area

Well No.	Location	Date Drilled	Depth (feet)	Depth to Water (ft)	Yield (gpm)	Perforated Interval (ft)
1	NW¼,SW¼, Sec. 21, T30S, R20E	1965	253	---	Plugged & Abandoned	---
2	NE¼,SE¼, Sec. 20, T30S, R20E	1965	65	21	33	24-65
3A	NW¼,SW¼, Sec. 30, T30S, R20E	1965	52	18	4	32-50
3B	NW¼,SW¼, Sec. 30, T30S, R20E	1971	46	19	---	19-37
4	SW¼,SW¼, Sec. 25, T30S, R19E	1965	77	26	13	44-77
5	NW¼,NE¼, Sec. 20, T30S, R20E	1968	78	23	44	---
6	SE¼,SW¼, Sec. 20, T30S, R20E	1988	80	8		---
7	SE¼,SW¼, Sec. 20, T30S, R20E	1990	72	8	40	32½-67½

Well No. 7 is currently the only well supplying water to the distribution system at Needles. No other wells have connections to the distribution system. Canyonlands Needles Outpost hauls chlorinated water from an overhead fill pipe at the water treatment plant for use at their facilities. Well No. 2 is designated as the backup well, but is not connected to the system.

A copy of the Driller's report for Well No. 7 is included in the Appendices of this report. The well was drilled to a total depth of 72 feet. The depth of the completed well is 67½ feet. The well was constructed of 6-inch PVC casing and well screen. PVC slotted well screen (0.020") was installed from 32½ to 67½ feet. The well was gravel packed using 20/40 sand to a depth of 26 feet below ground surface. A bentonite well seal was

placed from the top of the gravel pack to land surface. Installation of the surface seal was witnessed by Mark Page, Utah Division of Water Rights. Well No. 7 was tested by pumping at 40 gpm for 24 hours, resulting in 23 feet of drawdown. Land surface elevation at Well No. 7 is about 4920 feet. The design, construction, and geology of Well No. 7 are shown in Figure 5.

2.3 Aquifer Data - R309-113-9 (5)(a)(iv)

An aquifer test was conducted at Well No. 7 when it was constructed in 1990. The well was pumped at a rate of 40 gpm for 24 hours, resulting in 23 feet of drawdown. Analysis of water level recovery data from this test resulted in an estimate for transmissivity of 4000 ft^2/day. The primary source of water for Well No. 7 is a 20-foot sequence of coarse sand and gravel from 31-51 feet. Hydraulic conductivity for the aquifer is estimated to be 200 ft/day. These results are reasonable for a coarse sand and gravel aquifer (Heath, 1983). The raw data for this test is not available, so we could not conduct independent analyses.

Western Engineers conducted aquifer tests at Well No. 2 in 1988 (Chamberlain Architects, 1988). Well No. 2 is located about 2200 feet northeast of Well No. 7 and is in a similar hydrogeologic setting. The estimated transmissivity from those tests was 15,000 gpd/ft, or 2000 ft^2/day. Estimates of storage coefficient ranged from 0.0001 to 0.0002. These values are indicative of confined aquifer conditions, supporting the theory that the primary aquifer is the coarse sand and gravel layer confined by the underlying Cedar Mesa Sandstone and the overlying silty sand.

A Level II site investigation at the abandoned landfill ½ mile south of Well No. 7 found the water table slope in the alluvial sediments to be about 0.01 ft/ft toward the east (Roybal Corporation, 1998). The slope of the water table in the alluvial sediments would be expected to be approximately the same as the slope of the land surface

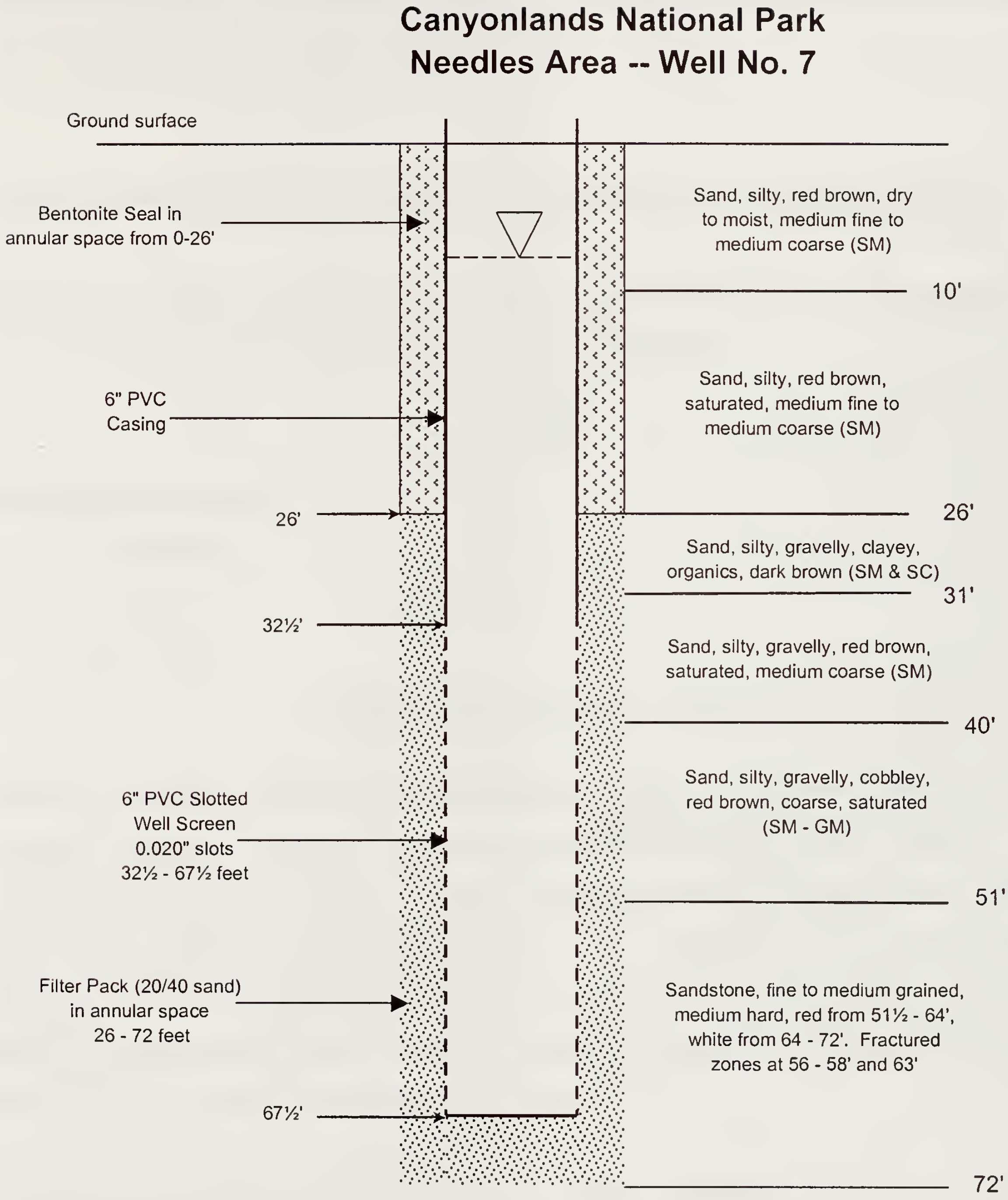

Canyonlands National Park
Needles Area -- Well No. 7
Ground surface
Bentonite Seal in annular space from 0-26'
6" PVC Casing
26'
32½'
6" PVC Slotted Well Screen 0.020" slots 32½ - 67½ feet
Filter Pack (20/40 sand) in annular space 26 - 72 feet
67½'
Sand, silty, red brown, dry to moist, medium fine to medium coarse (SM)
10'
Sand, silty, red brown, saturated, medium fine to medium coarse (SM)
26'
Sand, silty, gravelly, clayey, organics, dark brown (SM & SC)
31'
Sand, silty, gravelly, red brown, saturated, medium coarse (SM)
40'
Sand, silty, gravelly, cobbley, red brown, coarse, saturated (SM - GM)
51'
Sandstone, fine to medium grained, medium hard, red from 51½ - 64', white from 64 - 72'. Fractured zones at 56 - 58' and 63'
72'

Figure 5. Sketch of well completion, not to scale

following the creeks. In the vicinity of Well No. 7, the slope of the land surface parallel to the creeks is approximately 0.008 ft/ft.

2.4 Hydrogeologic Methods, Procedures, and Calculations - R309-113-9 (5)(a)(vii)

Simple groundwater velocities were calculated as a first approximation of the extent of source protection zones for Well No. 7. Using the equation;

$$v = \frac{K\,dh}{n\,dl}$$

and substituting values of;

K = 200 ft/day

n = 0.2

dh/dl = 0.01

$$v = \frac{K\,dh}{n\,dl} = \frac{200\,ft/d}{0.2}\,x\,0.01 = 10\,feet/day$$

This is a very high velocity for groundwater flow, but not unexpected since this analysis is based on data for a sand and gravel layer found in Well Nos. 7 and 2. We can compute a 3-year and 15-year travel zone for groundwater flowing toward these wells, even in the absence of groundwater pumping. Source protection zones for Well No. 7 would extend about 11,000 feet for the 3-year travel zone and about 55,000 feet (more than 10 miles) for the 15-year travel zone. Protection zones would extend even further after factoring in groundwater pumping from Well No. 7.

It is likely that the coarse sand and gravel deposits encountered in Well Nos. 7 and 2 are not continuous. These permeable deposits may extend downstream in the alluvium of Salt Creek. Well No. 5, constructed in that area, also produced a good quantity of water (44 gpm) before it filled with sand and was abandoned. Several other wells drilled in the Needles area of Canyonlands National Park did not produce much water because those wells did not intersect the more permeable sands and gravels. We do

not have a good idea of the extent of the permeable sands and gravels. Also, we do not have a good estimate of the hydraulic parameters of the finer-grained alluvium or the underlying sandstone.

Fortunately, the Needles area is very remote. The only potential sources of contamination are from National Park Service facilities. Potential contaminant sources at Needles Outpost would not affect the National Park Service well(s) because Needles Outpost is about a mile downgradient from the water supply wells. All of the Squaw Canyon drainage basin is within the boundary of the Park. The Salt Creek drainage basin is almost entirely within the park boundary. Only the uppermost part of the drainage basin on Salt Creek Mesa is outside the park boundary. That part of the Salt Creek drainage basin that is beyond the park boundary is a minimum of 11 miles upstream from the wells in the Needles area.

The optional two-mile radius includes all potential contaminant sources for Well No. 7. Therefore, the optional two-mile radius delineation will be used to delineate the wellhead protection area. The only potential contaminant sources in the Squaw Canyon Creek drainage basin are those under the direct control of the National Park Service. Those sources will be discussed in this plan. The only potential contaminant source in the Salt Creek drainage basin within two miles of Well No. 7 is the abandoned landfill, which will be discussed in this plan. There are no other contaminant sources in the Salt Creek drainage basin within the park boundary, a distance of 11 miles in the West Fork of Salt Creek and 14 miles in the East Fork of Salt Creek. The headwaters of the Salt Creek drainage basin are a high plateau (7000 feet) called Salt Creek Mesa. Primary land use in this area is summer grazing for cattle. It is unlikely that there are any potential contaminants present in significant quantities on the mesa.

2.5 Map Showing Boundaries of the DWSP Zones - R309-113-9 (5)(a)(viii)

Figure 6 is a map showing the area within two miles of the supply well.

2.6 Protected or Unprotected Aquifer Classification – R309-113-9 (3) & (6)

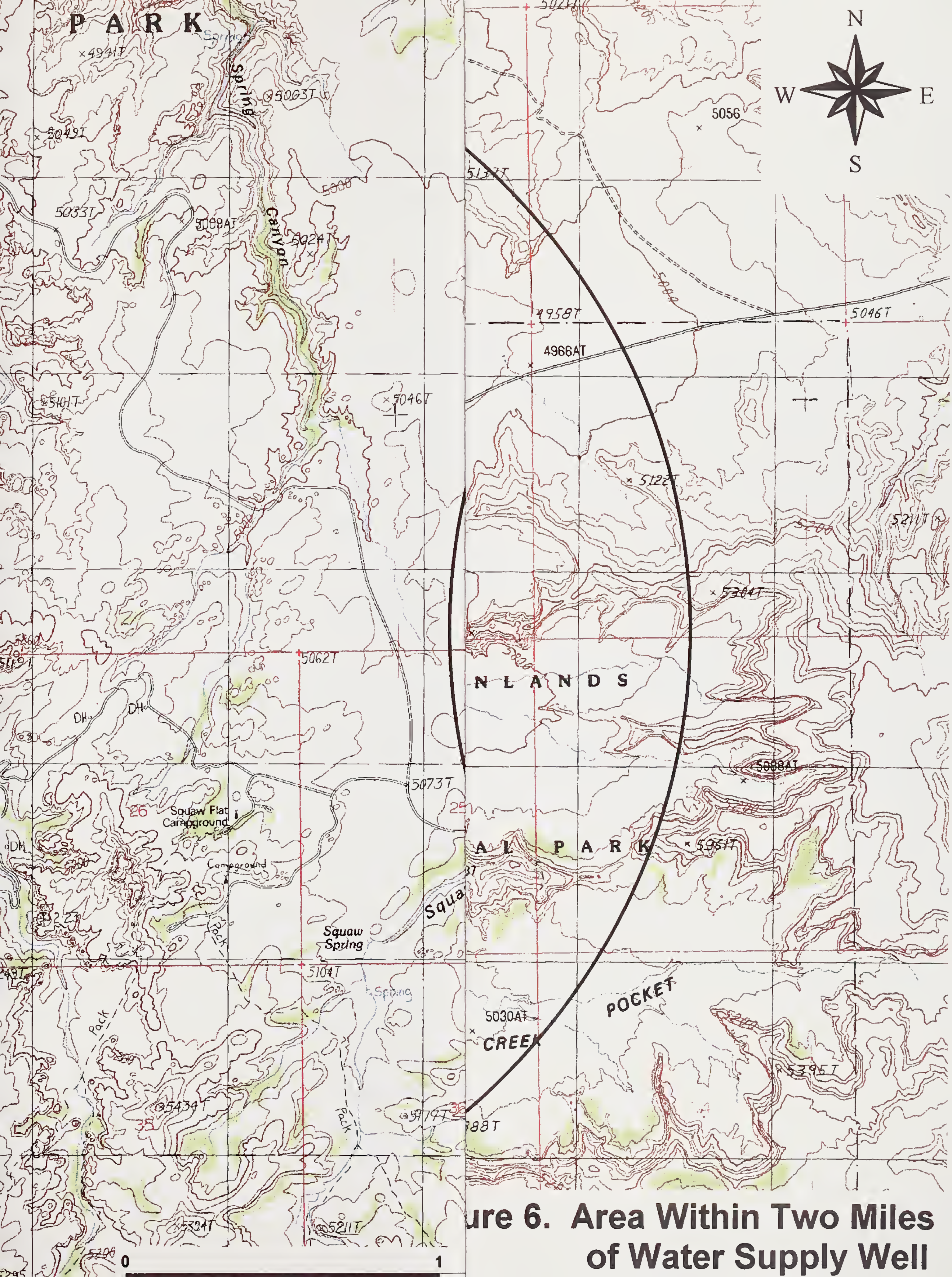
The aquifer supplying water to wells in the Needles area does not meet the criteria for classification as a protected aquifer, as described in the Utah DEQ guidelines for source water protection plans. In order for the aquifer to be classified as "protected" would require an overlying clay layer having a minimum thickness of 30 feet. There is no clay layer protecting the alluvial aquifer in the Needles area. The wells are completed in alluvium and the upper part of the Cedar Mesa Sandstone Member of the Cutler Formation. None of the wells in the Needles area is more than 100 feet deep.

3.0 THE INVENTORY OF POTENTIAL CONTAMINATION SOURCES - R309-113-10

3.1 List Potential Contamination Sources - R309-113-10 (1)

Potential contaminant sources within two miles of Well No. 7 include: sewer lines and leachfields, fuel tanks, and small quantities of paint, oil, fuel, solvents, etc. in the maintenance shop at the Park.

A privately owned and operated business, Canyonlands Needles Outpost, is located within two miles of Well No. 7. It is about 1¼ miles downgradient from Well No. 7 in the southwest corner of Section 16. The area was not inspected for potential contaminants. It is downgradient from the wells at Needles. Any contaminants that might be released at the Outpost would flow down Salt Creek toward the Colorado River. Groundwater flow in the area is also northeasterly, toward the Colorado River.



ure 6. Area Within Two Miles
of Water Supply Well

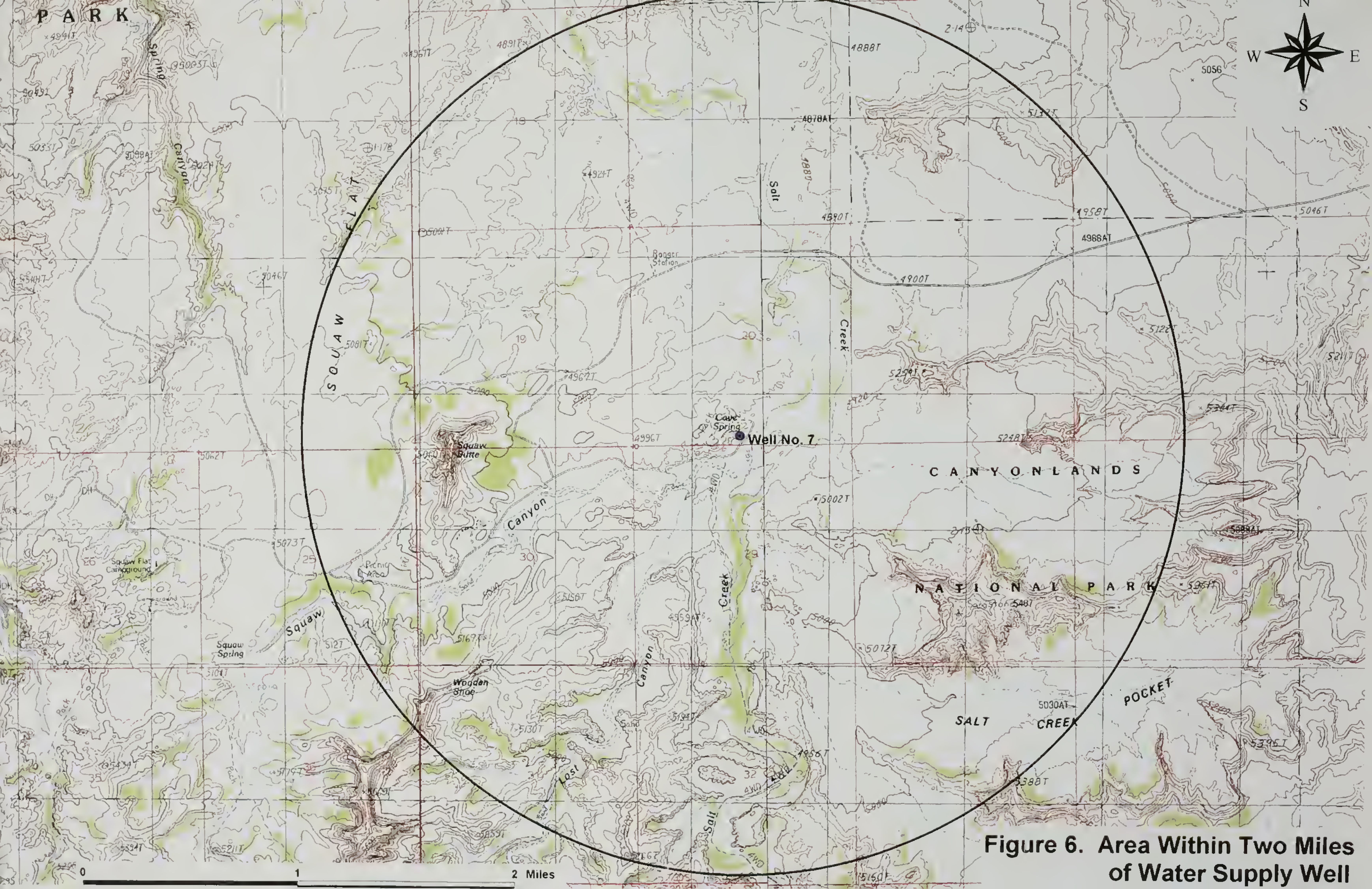


Figure 6. Area Within Two Miles of Water Supply Well

There are two septic leachfields associated with the employee housing area. Additionally, there are septic leachfields at the Visitor Center, the Maintenance Shop, and the Squaw Flat Campground.

At the generator building, there are various containers of oil and antifreeze. An above ground fuel tank contains diesel fuel for operating the generators.

At the Maintenance Shop, the Park stores cleaning supplies and paint for use in the Needles area. Outside there is a 4,000-gallon gasoline storage tank and an 18,000-gallon propane tank. In the fueling building are various containers of motor oil, gasoline mixes for 2-cycle engines, paint, and sealer.

There is an abandoned landfill about ½ mile south of Well No. 7. The landfill was operated from about 1966 to 1988. Garbage from the campground and residential areas was disposed in trenches dug at the site. After the plastic bags of trash were placed in the pit, they were covered with dirt. Canyonlands Resort, the business venture that preceded Needles Outpost, also deposited garbage from their business operation at the landfill. Canyonlands Resort also operated a small airstrip and probably sent waste associated with airstrip operation to the landfill. After 1988, garbage was stored in containers and transported out of the Park by a private hauler.

A Level II site investigation of the landfill site was performed by Roybal Corporation (1998). The investigation detected toluene, ethylbenzene, and xylene, but the concentrations were substantially lower than Utah DEQ regulatory levels. These organic chemicals are generally indicative of gasoline spills. Metals concentrations were all below the Utah DEQ regulatory levels. Therefore, it does not appear that there is significant contaminant transport from the abandoned landfill.

3.2 Identify Hazards:

Potential contaminant sources, hazardous substances associated with each of the possible potential contaminant sources, and approximate quantities of each hazardous substance are listed in Table 3.

3.3 Prioritize the Inventory - R309-113-10 (1)

The abandoned landfill is the greatest potential threat to the drinking water supply for the Needles area. Although it is generally believed that most of the material placed in the landfill was common household garbage, unknown quantities of unknown material from the maintenance shop may have been placed in the landfill. Human sewage pumped from vault toilets may have been placed in the landfill. The landfill was unlined and would have a direct hydrologic connection with alluvial aquifers in adjacent creeks.

Fuel storage tanks (diesel, gasoline, and propane) are a secondary threat to the water supply. Fuel storage tanks are located upgradient, about one mile up Squaw Canyon Creek from Well No. 7. Contents of tanks are regularly monitored to detect leaks. Secondary containment is provided for all tanks.

Paint, thinner, solvents, fuel, oil, etc. are stored in small containers at the maintenance shop, fueling building, and generator building. These materials are generally stored in small quantities, in areas where leaks could be readily observed, and secondary containment is provided.

Abandoned wells may present a risk to the water supply. Well No. 5 is downgradient from Well No. 7 and presents no risk. Other wells that are upgradient from Well No. 7 are capped, but have not been sealed. Well Nos. 3A, 3B, 4, and 5 should be plugged and abandoned. PVC monitor wells near Well 3A and 3B and Well No. 2 should also

Table 3. Hazardous substances associated with each potential contaminant source

Potential Source	Hazardous Substances	Approximate Quantity
Abandoned landfill	Believed to be primarily household garbage with some contribution from maintenance shop	Unknown
Fuel tanks	Gasoline	One 4,000-gallon tank, above ground.
	Diesel fuel	One 6000-gallon tank, above ground
	LPG (Propane)	All tanks are above ground. 18,000 gallons at maintenance compound 2,000 gallons at visitor center 500 gallons at water treatment building Two 250 gallon tanks at campground
Fueling building	Motor oil, fuel mixes, paint, sealer	Various quantities in containers generally less than 1-gallon size. Approximately 25-30 containers
Maintenance shop	Solvents, degreasers, cleaning solutions	Various quantities in 1-5 gallon containers
	Paint and floor sealer	10 5-gallon buckets
	Paint locker	Various quantities, generally 1-gallon or less, stored in a paint locker
Generator building	Lubricating oil, antifreeze	Several 1-5 gallon containers and 55-gallon barrels
Sewer lines Septic leachfields	Sewage	Sewage from the visitor center, administrative offices, maintenance area, housing area, and campground is collected and disposed in septic leachfields at various locations
Abandoned wells	Pathway for contaminants to enter aquifer	5 wells

be plugged and abandoned. Test Well No. 6 and associated piezometers and monitor wells at Cave Springs should be plugged and abandoned. Abandoned wells provide a pathway for contaminants to enter the aquifer.

Septic leachfields present a negligible risk to the water supply. The largest volume leachfields (Visitor Center, employee housing area, campground) are located downgradient, or in areas where the effluent would flow away from Well No. 7. The leachfield serving the Maintenance Shop is about a mile upgradient from Well No. 7.

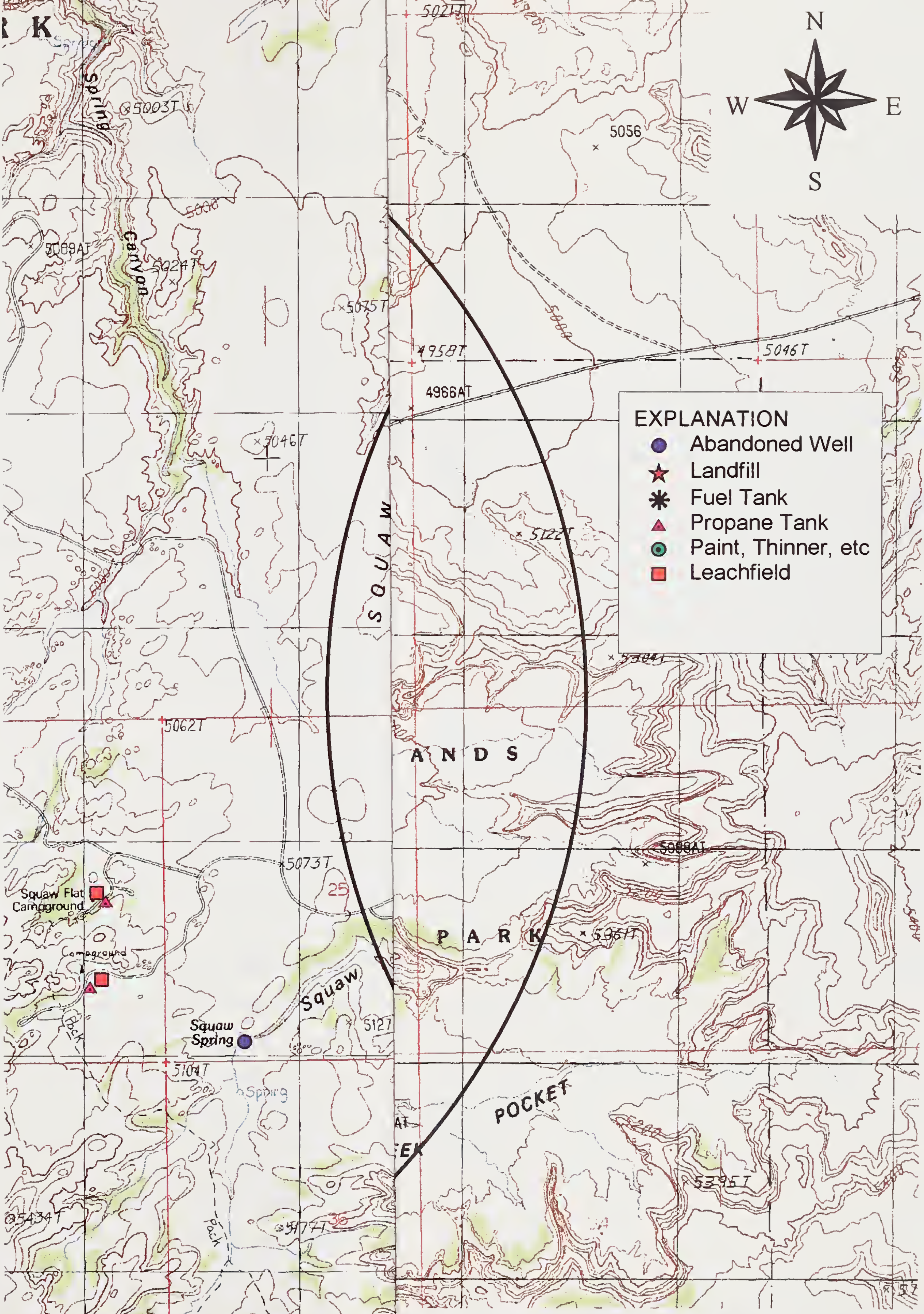
3.4 Potential Contamination Source Location - R309-113-10 (1)

None of the potential contaminant sources is within the Zone 1 protection zone, 100-foot radius from the well. The nearest potential contaminant source is the abandoned landfill located approximately ½ mile south of Well No. 7. All potential contaminant sources identified in Table 3, with the exception of the septic leachfield at Squaw Flat Campground, are within the two-mile radius from the well. There are no potential contaminant sources upgradient of Well No. 7 for a distance of at least 11 miles, other than those potential sources identified in the preceding sections of this plan.

All potential contaminant sources within two miles of Well No. 7 are under the direct control of the National Park Service.

3.5 Potential Contamination Sources Plotted on Map

Potential contamination sources are plotted on the map in Figure 7.



re 7. Potential Contaminant Sources in the Needles Area

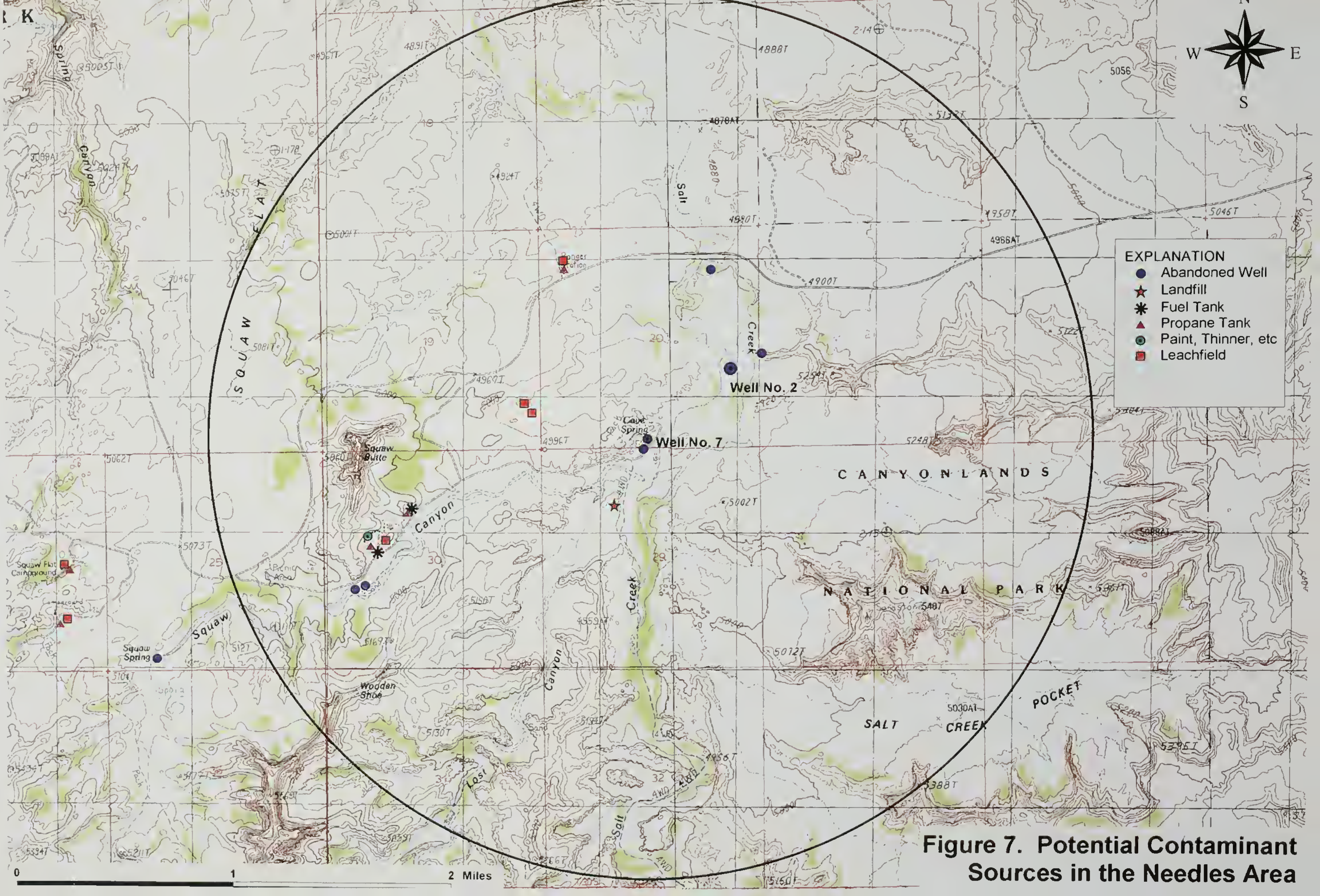


Figure 7. Potential Contaminant Sources in the Needles Area

4.0 THE ASSESSMENT OF POTENTIAL CONTAMINATION SOURCE HAZARDS

All potential contamination sources are under the direct control of the National Park Service. Potential contaminants at the Park are primarily associated with the maintenance shop, including fuel storage tanks. Solvents, degreasers, paint, and similar materials (which might be classified as hazardous) are purchased and stored in small quantities, reducing the potential for release of large quantities of contaminants. The Park will continue to follow Best Management Practices to prevent or control release of potential contaminants. These practices include routine monitoring of fuel storage tanks, secondary containment vessels for fuel tanks and oil drums, and eliminating large inventories of potential contaminants

Septic leachfields and LPG tanks at the Campground, Visitor Center, and employee housing areas are downgradient from Well No. 7. Any release of potential contaminants at these areas would flow away from the water supply well.

Fuel storage tanks are equipped with computerized interstitial leak detection monitoring devices and are inspected on a regular basis. Tanks are above ground to allow visual observation of any leaks or spills. Secondary containment is provided for 110% of the tank capacities. Distribution lines are double-walled steel.

Secondary containment vessels are provided for oil and fuel storage containers. Paint, solvents, cleaning fluids, and similar materials are stored on shelves in buildings with concrete floors. There are no floor drains in areas where potential contaminants are stored.

Paint, solvents, cleaning fluids, etc. are purchased on an as needed basis. Only negligible quantities are stored on site.

Potential contaminant sources mentioned above are adequately controlled through a combination of hydrogeologic conditions and regulatory, operational, physical, and negligible quantity controls. No further land management strategies will be planned or implemented, unless conditions change.

Potential contaminants emanating from the abandoned landfill are not controlled. Site investigations and groundwater monitoring have provided no evidence of contamination at the abandoned landfill. The abandoned landfill is an uncontrolled potential contaminant source.

5.0 THE MANAGEMENT PROGRAM FOR EXISTING POTENTIAL CONTAMINATION SOURCES - R309-113-11

In general, existing regulatory, operational, physical, and negligible quantity controls are adequate to prevent the accidental spill or release of potential contaminants. Recommendations for minor changes to insure better protection of the groundwater resources in the Needles area are in the last paragraph of this section.

Several site investigations and groundwater monitoring at the abandoned landfill have failed to identify any groundwater contamination or contaminant transport away from the landfill. It may be that no hazardous materials were ever disposed at the landfill, or that quantities of hazardous materials were negligible. It may also be that natural attenuation and dilution have effectively eliminated hazardous materials from the site. Continued monitoring at Well No. 7 will be conducted, as required for public water supplies, to detect any contamination that might emanate from the abandoned landfill. Additional water quality monitoring is planned in 2001 for the monitor wells at the landfill. The four monitor wells at the landfill, Well No. 7, and Well No. 2 should be resampled for the complete suite of organic and inorganic parameters, and metals to verify that there is no apparent groundwater contamination from the abandoned landfill.

Water supply wells in the area that are no longer used should be plugged and abandoned according to Utah regulations. Abandoned wells present a small, but real, risk to the water supply. Well No. 5 is downgradient from Well No. 7 and presents no risk. Other wells that are upgradient from Well No. 7 are capped, but have not been sealed. Wells Nos.3A, 3B, 4, and 5 should be plugged and abandoned. PVC monitor wells near Well Nos.3A and 3B and Well No. 2 should also be plugged and abandoned. Well No. 6, and associated piezometers and monitor wells, at Cave Springs should be plugged and abandoned. The Park is scheduled to receive funding through the repair/rehab program in FY-2002 to plug and abandon unused wells.

6.0 THE MANAGEMENT PROGRAM FOR FUTURE POTENTIAL CONTAMINATION SOURCES - R309-113-12

6.1 Management Program - R309-113-13 (4)

If there are any proposed changes to current land use and land management practices within two miles of the well, the National Park Service will review those proposed changes to determine whether the proposed change might have a deleterious impact on the water supply for the Park. No such changes are anticipated, as the area is remote and rural. The only land within two miles of Well No. 7 that is not under the direct control of the National Park Service is in Section 16, the location of privately owned Canyonlands Needles Outpost. Facilities at the Outpost are downgradient from Well No. 7 and have no potential to adversely impact groundwater resources at Well No. 7.

Most of the area upgradient of Well No. 7 is under the direct control of the National Park Service. All of the Squaw Canyon drainage basin is within the boundary of the Park. The Salt Creek drainage basin is almost entirely within the park boundary. Only the

uppermost part of the drainage basin on Salt Creek Mesa is outside the park boundary. That part of the Salt Creek drainage basin that is beyond the Park boundary is a minimum of 11 miles upstream from the wells in the Needles area (Figure 8).

7.0 THE IMPLEMENTATION SCHEDULE - R309-113-7 (1)(e)

No new land management strategies will be implemented under this plan. Current management practices are adequate to protect the groundwater resources at Well No. 7, which supplies all National Park Service facilities in the Needles area.

8.0 THE RESOURCE EVALUATION - R309-113-7 (1)(f)

The Park will continue to monitor water quality at monitoring wells at the abandoned landfill and at Well No. 7, as necessary, to comply with regulations of Utah DEQ and to insure that the water supply is safe. Additional funding will be programmed in FY 2002 to plug and abandon unused wells in the area.

Land use and ownership in this remote area makes it likely that no potential contaminant sources would ever be located within the source area for this well.

9.0 THE RECORDKEEPING SECTION - R309-113-7 (1)(g)

This plan was developed by National Park Service staff. The plan will be reviewed and updated, as necessary, in 5 years, January 2006.

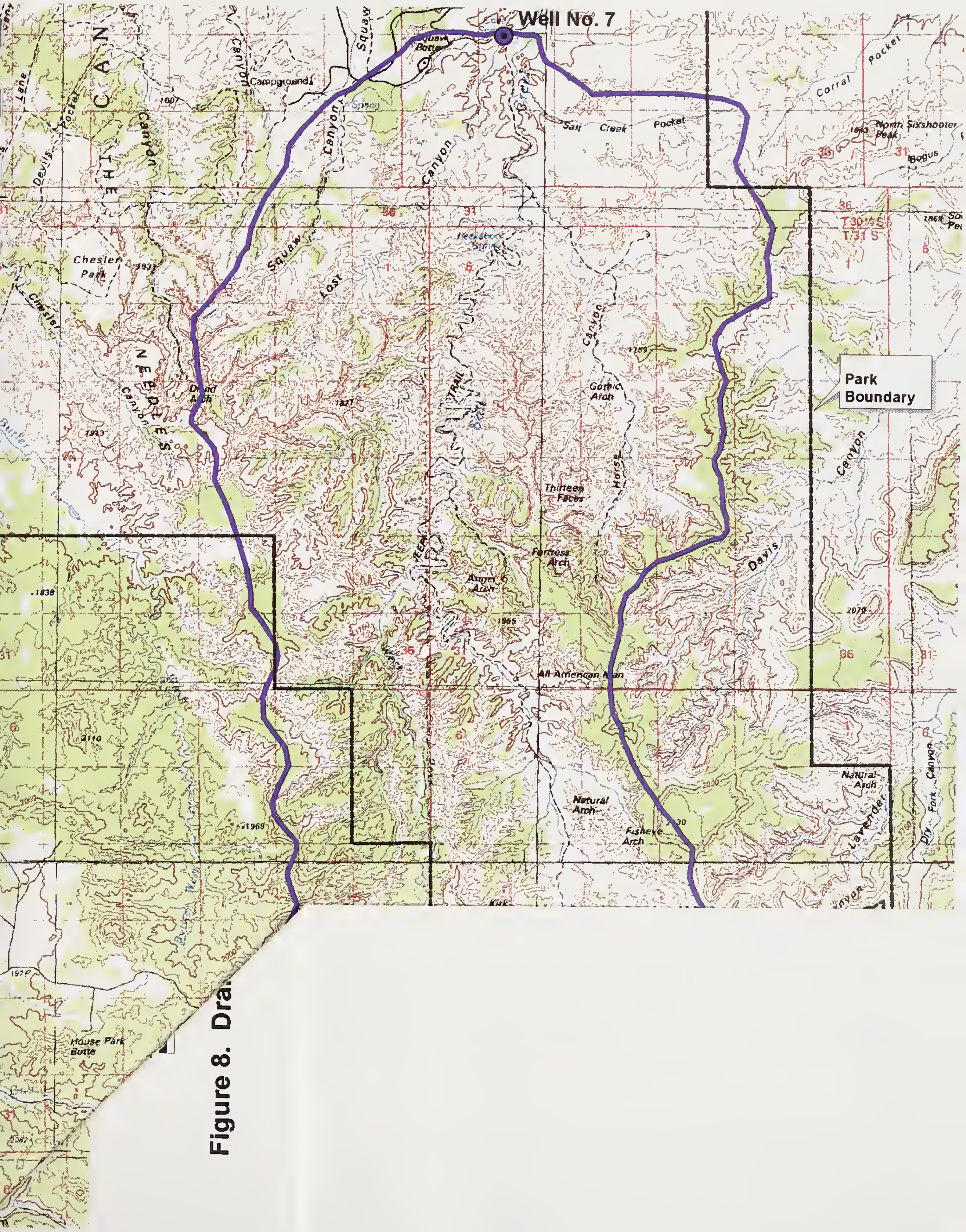

Well No. 7
Park Boundary
Squaw Butte
Campground
Squaw Canyon
Salt Creek Pocket
Corral Pocket
North Sixshooter Peak
Bogus
Devils Pocket
Lane
Chesler Park
Chesler
NEEDLES
Druid Arch
Elephant Canyon
Lost Canyon
Horse Canyon
Gothic Arch
Thirteen Faces
Fortress Arch
Angel Arch
All American Man
Davis Canyon
Natural Arch
Fisheye Arch
Lavender Canyon
Dry Fork Canyon
Butler Wash
House Park Butte
Kirk
T30½S
T31 S
36
31
1
6

Figure 8. Dra

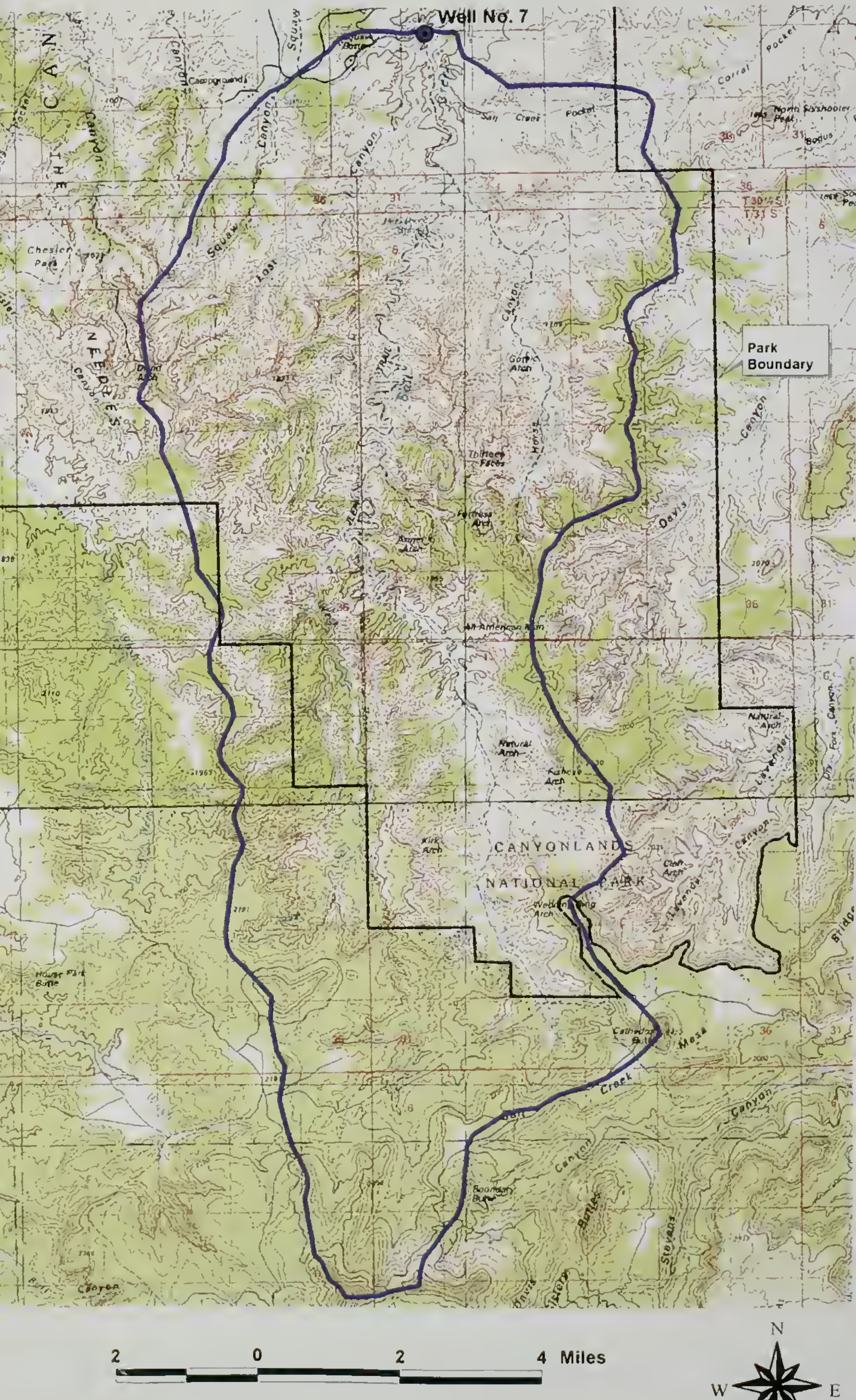


Figure 8. Drainage Basin upstream from Well No. 7

10.0 THE CONTINGENCY PLAN - R309-113-14

Well No. 2 is currently designated as the backup supply for National Park Service facilities in the Needles area. Additional water quality testing would be required for approval to connect Well No. 2 to the National Park Service distribution system. Currently there is no connection. A permanent connection from Well No. 2 would be problematic, as it would require the pipeline to cross the drainage of Squaw Canyon Creek. Floodflows could scour the channel, causing breaks in the pipeline to Well No. 2.

Although unlikely, the alluvial aquifer supplying Well No. 7 could become contaminated from spills or leaks of materials at the maintenance shop and fuel storage areas. The abandoned landfill might still prove to be a source of uncontrolled groundwater contamination. Should either of these occur, the Park could probably identify an alternative location for a new well further up Salt Creek, upgradient from all potential contaminant sources.

References

Chamberlain Architects, 1988, Comprehensive Plan Canyonlands National Park Needles District,

Ecosystem Research Institute, 1984a, Water Resources Assessment Canyonlands National Park Needles District and Adjacent BLM Lands, Volume I, 124 pp.

Ecosystem Research Institute, 1984b, Water Resources Description and Data Base Canyonlands National Park Needles District and Adjacent BLM Lands, Volume III

Heath, Ralph C., 1983, Basic Ground-Water Hydrology, USGS Water-Supply Paper 2220, 84 pp.

Huntoon, P.W., 1977, The Hydrogeologic Feasibility of Developing Ground-Water Supplies in the Northern Part of Canyonlands National Park and Natural Bridges National Monument, Utah, Wyoming Water Resources Research Institute and Department of Geology, University of Wyoming, Laramie, 24 pp.

Richter, Henry R., Jr., 1980, Ground Water Resources in the Part of Canyonlands National Park East of the Colorado River and Contiguous Bureau of Land Management Lands, Utah, M.S. Thesis, University of Wyoming Geology Department, 80 pp.

Roybal Corporation, 1998, National Park Service Needles Landfill Site Canyonlands National Park Level II Site Investigation, 13 pp.

Sumison, C.T. and Bolke, E.L., 1972, Water Resources of Part of Canyonlands National Park, Southeastern Utah, USGS Open-File Report, 1972, 75 pp.

Utah Division of Drinking Water website, http://www.deq.state.ut.us/eqdw/Index.html

Appendices

NEEDLES DISTRICT WATER WELLS

WELL NO. 1: Salt Creek - Abandoned

LOCATION: 38°35' W, 3807 ft. from N½ Corner, Sec. 21, T30S, R20E, SLB&M, San Juan County

DATE DRILLED: March 14, 1965

DEPTH: 253 ft.

STATIC WATER LEVEL: N/A

WELL LOG:

Clay/sand	0 - 16 ft.
Sandstone	16 - 200 ft.
Lime (stone)	200 - 230 ft.
Salt water (seep)	207 ft.
Sandstone	230 - 253 ft.

The well was abandoned; plugged at 25 ft. and filled to the surface.

# # #

NEEDLES DISTRICT WATER WELLS

WELL NO. 2: Salt Creek Well

LOCATION: S 10°5' W, 3433 ft. from NE corner, Sec. 20, T30S, R20E, SLB&M, San Juan County

DATE DRILLED: April 10, 1965

DEPTH: 65 ft.

STATIC WATER LEVEL: 21 ft.

WELL LOG:

Sand	0 - 5 ft.
Sand/silt	5 - 15 ft.
Sand	15 - 30 ft.
Sand/clay	30 - 32 ft.
Water	32 ft.
Sand (with water	32 - 50 ft.
Sand/gravel (with water)	50 - 55 ft.
Sandstone	55 - 65 ft.

PUMP TEST: 33 gpm with 10 ft. drawdown after 48 hrs.

WATER TEMPERATURE: 58° when drilled.

CASING: 55 ft. of 8 in. casing;

67 ft. of 6 in. casing perforated between 24 ft. and 65 ft.

CONSTRUCTION: Surface sealed to 10 ft. with cement.

PUMPING WATER LEVEL: 24 ft.

# # #

NEEDLES DISTRICT WATER WELLS

WELL NO. 3A: Headquarters Well

LOCATION: N 25°29' E, 2019 ft. from SW corner, Sec. 30,
T30S, R20E, SLB&M, San Juan County

DATE DRILLED: April 27, 1965

DEPTH: 52 ft.

STATIC WATER LEVEL: 18 ft.

WELL LOG:	Sand	0 - 15 ft.
	Sand and gravel	15 - 34 ft.
	Water	32 ft.
	Sandstone	34 - 38 ft.
	Sand	38 - 42 ft.
	Sandstone	42 - 52 ft.

PUMP TEST: 4 gpm with 20 ft. drawdown after 48 hrs.

WATER TEMPERATURE: 60°F when drilled.

CASING: 33 ft. of 8 in. casing;

52 ft. of 6 in. casing perforated between 32 ft. and 50 ft.

CONSTRUCTION: Gravel packed from 42 ft. to 30 ft.,

surface sealed to 10 ft. with cement.

PUMPING WATER LEVEL: 38 ft.

# # #

NEEDLES DISTRICT WATER WELLS

WELL NO. 3B: Headquarters Well

LOCATION: N 25°29' E, 2019 ft. from SW corner, Sec. 30, T30S, R20E, SLB&M, San Juan County (located 55 ft. from Well No. 3A)

DATE DRILLED: May 20, 1971

DEPTH: 46 ft.

STATIC WATER LEVEL: 19 ft.

WELL LOG:

Sand	0 - 26 ft.
Sand and gravel	26 - 34 ft.
Water	? ft.
Sandstone	34 - 46 ft.

PUMP TEST: Unknown

WATER TEMPERATURE: Unknown

CASING: 37 ft. of 10 in. casing;

43 ft. of 6 in. casing perforated between 19 ft. and 37 ft.

CONSTRUCTION: Floor plate at 39 ft.;

Well screen 26 ft. to 32 ft.;

Surface seal unknown

PUMPING WATER LEVEL: In well screen area.

# # #

NEEDLES DISTRICT WATER WELL

WELL NO. 4: Squaw Springs Well

LOCATION: N 78°12' W, 1347 ft. from S½ corner, Sec. 25,
T30S, R19E, SLB&M, San Juan County

DATE DRILLED: May 20, 1965

DEPTH: 77 ft.

STATIC WATER LEVEL: 26 ft.

WELL LOG:	Sand	0 - 8 ft.
	Sandstone	8 - 77 ft.
	Water	51½ ft.

PUMP TEST: 13 gpm with 28 ft. drawdown after 24 hrs.

WATER TEMPERATURE: 59°F when drilled.

CASING: 77 ft. of 6 in. casing perforated from 44 ft. to 77 ft.

CONSTRUCTION: Surface sealed to 10 ft. with cement inside 8 in. casing.

PUMPING WATER LEVEL: N/A

# # #

Well No. 7

Form 113-[illegible]

Examined ______
Recorded: E. C. ______ T. R. ______
Location Sheet ______

REPORT OF WELL DRILLER
STATE OF UTAH

Application No. 05-554 (A-157
Claim No. ______
Coordinate No. ______

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:
Name US National Park Service
Address Box 25287 Denver, Colo. 80225

(2) LOCATION OF WELL:
County San Juan Ground Water Basin ______ (leave blank)
North 240 feet East 2700 feet from SW Corner of Section 20 T. 30 S. R. 20 E SLBM (strike out words not needed)

(3) NATURE OF WORK (check):
New Well ☒ Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐
If abandonment, describe material and procedure: ______

(4) NATURE OF USE (check):
Domestic ☒ Industrial ☐ Municipal ☐ Stockwater ☐
Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check):
Rotary ☒ Dug ☐ Jetted ☐
Cable ☐ Driven ☐ Bored ☐

(6) CASING SCHEDULE: Threaded ☒ Welded ☐
6" Diam. from 0 feet to 34 feet Gage Sch 80
______" Diam. from ______ feet to ______ feet Gage ______
______" Diam. from ______ feet to ______ feet Gage ______
New ☒ Sch 80 Reject ☐ Used ☐

(7) PERFORATIONS: Perforated? Yes ☐ No ☐
Type of perforator used ______
Size of perforations ______ inches by ______ inches
______ perforations from ______ feet to ______ feet
______ perforations from ______ feet to ______ feet
______ perforations from ______ feet to ______ feet
______ perforations from ______ feet to ______ feet
______ perforations from ______ feet to ______ feet

(8) SCREENS: Well screen installed? Yes ☒ No ☐
Manufacturer's Name ______
Type Flush Joint PVC Model No. Sch 80
Diam. 6 Slot size 0.020 Set from ______ ft. to ______
Diam. ______ Slot size ______ Set from ______ ft. to ______

(9) CONSTRUCTION:
Was well gravel packed? Yes ☒ No ☐ Size of gravel: 20/40
Gravel placed from 34 feet to 72 feet
Was a surface seal provided? Yes ☒ No ☐
To what depth? 34' to Surface feet
Material used in seal: Ben Seal
Did any strata contain unusable water? Yes ☒ No ☐
Type of water: ______ Depth of strata ______
Method of sealing strata off: Ben Seal
Surface Seal
Was surface casing used? Yes ☒ No ☐
Was it cemented in place? Yes ☐ No ☒

(10) WATER LEVELS:
Static level ______ feet below land surface Date ______
Artesian pressure ______ feet above land surface Date ______

LOG RECEIVED:

(11) FLOWING WELL:
Controlled by (check) Valve ☐ Cap ☐ Plug ☐ No Control ☐
Does well leak around casing? Yes ☐ No ☐

(12) WELL TESTS:
Drawdown is the distance in feet the water level is lowered below static level.
Was a pump test made? Yes ☒ No ☐ If so, by whom? Western Engineering
Yield: 40 gal./min. with 23 feet drawdown after 24 hours
Bailer test ______ gal./min. with ______ feet drawdown after ______ hours
Artesian flow ______ g.p.m. Date ______
Temperature of water ______ Was a chemical analysis made? No ☐ Yes ☐

(13) WELL LOG:
Diameter of well 12¼ - 9⅞ inches
Depth drilled 72 feet. Depth of completed well 69 feet

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

DEPTH From	DEPTH To	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other	REMARKS
0	14			X								Brown
14	28			X	X							water at 15'
28	31	X		X								Fine Sand Blackish cl
31	38			X	X							Small Gravel
38	51			X	X	X						Big Gravel - Water
51	68									X		Adaye Sand Stone
68	70									X		White fractured
70	72									X		White & Brown
												water ZONE
												38 To 51'

Work started 10-25 1990 Completed 11-12 1990

(14) PUMP:
Manufacturer's Name ______
Type: ______ H. P. ______
Depth to pump or bowls ______ feet

Well Driller's Statement:

This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.

Name Tracy Drilling Co (Person, firm, or corporation) (Type or print)
Address East Route Monticello Ut. 84535
(Signed) Allen Tracy (Well Driller)
License No. 351 Date ______ 19__

USE OTHER SIDE FOR ADDITIONAL REMARKS

AH DIVISION OF DRINKING WATER

PUBLIC WATER SUPPLY INFORMATION SYSTEM
01/11/01

WATER SYSTEM NUMBER: 19042

NAME: CANYONLANDS NEEDLES HQ
OWNER: NATIONAL PARK SERVICE
ADDRESS: 2282 SW RESOURCE BLV
MOAB UT 84532
AREA: SAN JUAN
COUNTY: SAN JUAN
TYPE: NATIONAL PARKS & REC.
MANGR.: BILL KEY
PHONE: 259-3911
OPER.: JOHN JOHNSON
PHONE: 259-8336

RATING: APPROVED
RATING ASSIGNED: 04/09/96
INVENTORY REVIEWED: 07/31/00
INVENTORIED BY: HANSEN
LAST SURVEYED: 06/02/00
SURVEYED BY: MEYER
LAST PLAN APPR.: 03/26/91
SYSTEM ENGINEER: NPS
BEGIN OPERATION: 01/01
END OPERATION: 12/31

POPULATION: 30
RESIDENTIAL CONN.: 19
OTHER CONNECTIONS: 2
TOTAL NO. CONNECTIONS: 21
TYPE OTHER CONN: NO CLASSIFICATION
OUTSIDE USE PERMITTED: NO
CALC PEAK DEMAND (GPD): 16,800
GPD/1440 = DEMAND (GPM): 1,200
PEAK HOURLY DEMAND: 9,600

-BACTERIOLOGIC QUALITY-
SAMPLES REQ/QUAR.: 1
QUAR. INSUF. SAMPLS: 0
QUAR. UNSAT RESULT: 0
RECORD SATIS.: YES
12 MOS END.: 12/31/99

- - - - -STORAGE- - - - -
NUMBER OF UNITS: 3
MATERIAL: FIBERGLASS
CAPACITY: 60,000
ADEQUATE: YES

- - - TREATMENT- - - -
TYPE: IRON REMOVAL
PLANT: MN-GREENSAND
CAPACITY (MGD): 580.36
INSTALLED: 1991

- - - - - DISTRIBUTION - - - - -
PUMP/GRAVITY: PUMPED
FIRE HYDRANTS: YES
PRESSURE ADEQ.: YES
PCT METERED: 100
MASTER METER:

* NO.	SOURCE TYPE	SOURCE NAME	- - WELL - - TYPE	DIA	YIELD (GPM)	SOURCE PROT. CONCUR	TYPE OF TREATMENT	SOURCE LOCATION -LATITUDE - DEG MIN SEC	-LONGITUDE- DEG MIN SEC
*N01	WELL	WELL 3A(OUT)	SHALLOW				NONE		.
*N02	WELL	WELL 3B(OUT)	SHALLOW				NONE	.	.
*N03	WELL	WELL #2		6			NONE	38 09 23.0	109 45 05.2
04	WELL (GW)	CAVE SPRINGS	SHALLOW	6	40		IRON REMOVAL	38 09 23.0	109 45 05.2

STAFF COMMENTS:

PRIOR WTP BUILT 1964 & TREATED DATE: 03/28/91 INITIALS: BHH
0.005 MGD.NEW GREENSAND (4-91)
WTP CAN RUN @ 25 GPM MAX. WILL
ABAND 2 OLD TANKS OF 25800 GAL

Summary of Chemical Quality (Form 1)

CANYONLANDS NEEDLES HO

System Number	Date Collected	Source #	Source Name	In Use ?	Lab Number	Total Arsenic (µg/L)	Total Antimony (µg/L)	Beryllium (µg/L)	Total Cadmium (µg/L)	Cyanide (µg/L)	Turbidity (NTU)	Dissolved Iron (µg/L	Total Iron (mg/L)	Total Managanese (µg/L)
19042	07/16/83	01	WELL 3A(OUT)		C832517	< 0.5			< 1		1.6		0.03	55
19042	09/11/83	02	WELL 3B(OUT)		C833462						20.5			
19042	07/16/83	02	WELL 3B(OUT)		C832518	1			1		7.7		0.03	20
19042	08/29/89	03	WELL #2		C895936	< 5			< 1		12		0.28	120
19042	05/03/88	03	WELL #2		C882345									
19042	08/02/84	03	WELL #2		C842985						15			
19042	07/24/84	03	WELL #2		C842986						10			
19042	06/01/84	03	WELL #2		C841873						15			
19042	05/28/84	03	WELL #2		C841769						25			
19042	05/16/84	03	WELL #2		C841656						8			
19042	03/20/84	03	WELL #2		C840932	9.5			1		65.3		2.33	80
19042	03/19/81	03	WELL #2		C811132	4			< 1		0.8		0.37	45
19042	09/20/99	04	CAVE SPRINGS	I	C909115									
19042	04/12/99	04	CAVE SPRINGS	I	C992670									
19042	07/07/97	04	CAVE SPRINGS	I	C976353									
19042	09/24/96	04	CAVE SPRINGS	I	C968758									
19042	08/28/95	04	CAVE SPRINGS	I	C959266	< 5	<3	1	< 1	50	1.5		0.54	40
19042	06/20/94	04	CAVE SPRINGS	I	C946102									
19042	10/18/93	04	CAVE SPRINGS	I	C930572									
19042	04/27/93	04	CAVE SPRINGS	I	C933070									
19042	11/13/90	04	CAVE SPRINGS	I	x362691	< 5			< 1				0.38	0.1
Primary or secondary drinking water limit :						**50**	**6**	**4**	**5**	**200**	**5**	**300**	**0.3**	**50**

Summary of Chemical Quality (Form 2)

CANYONLANDS NEEDLES HO

System Number	Date Collected	Source #	Source Name	In Use ?	Lab Number	Nitrite as N (mg/L)	Nitrate as N (mg/L)	Total Mercury (µg/L)	Dissolved Selenium (µg/L)	Total Selenium (µg/L)	Sulfate (mg/L)	TDS (mg/L)	Thallium (µg/L)
19042	07/16/83	01	WELL 3A(OUT)	N	C832517	< 0.02	0.04	< 0.1		< 0.5	101	564	
19042	09/11/83	02	WELL 3B(OUT)	N	C833462								
19042	07/16/83	02	WELL 3B(OUT)	N	C832518	< 0.02	0.04	< 0.1		< 0.5	106	575	
19042	08/29/89	03	WELL #2	N	C895936	< 0.01	< 0.01	0.2		< 1	280	1180	
19042	05/03/88	03	WELL #2	N	C882345		0.01				250		
19042	08/02/84	03	WELL #2	N	C842985								
19042	07/24/84	03	WELL #2	N	C842986								
19042	06/01/84	03	WELL #2	N	C841873								
19042	05/28/84	03	WELL #2	N	C841769								
19042	05/16/84	03	WELL #2	N	C841656								
19042	03/20/84	03	WELL #2	N	C840932	0.04	< 0.01	< 0.1		< 0.5	222	914	
19042	03/19/81	03	WELL #2	N	C811132	< 0.05	< 0.05	< 0.1		< 1	188	854	
19042	09/20/99	04	CAVE SPRINGS	I	C909115	< 0.1	< 0.1						
19042	04/12/99	04	CAVE SPRINGS	I	C992670	< 0.1	< 0.1						
19042	07/07/97	04	CAVE SPRINGS	I	C976353	< 0.02	< 0.02						
19042	09/24/96	04	CAVE SPRINGS	I	C968758	< 0.02	< 0.02						
19042	08/28/95	04	CAVE SPRINGS	I	C959266	< 0.02	< 0.02	< 0.2		< 1	54	326	< 1
19042	06/20/94	04	CAVE SPRINGS	I	C946102	< 0.02	< 0.02						
19042	10/18/93	04	CAVE SPRINGS	I	C930572						46		
19042	04/27/93	04	CAVE SPRINGS	I	C933070	< 0.02	< 0.02						
19042	11/13/90	04	CAVE SPRINGS	I	x362691			< 0.2		< 0.1			
Primary or secondary drinking water limit :						1	10	2	50	50	500	1000	2

01/19/01

Water Quality Measurements
For Corrosion Control

CANYONLANDS NEEDLES HQ

Source Name	Source #	Lab Number	Date Collected	pH	Alka-linity (mg/L)	Tot Fe (mg/L)	Tot Mn (µg/L)	Turbid-ity (NTU)	Ca (mg/L)	Total Hard-ness (mg/L)	TDS (mg/L)	Specific Con-ductance µmho/cm	Chloride (mg/L)	Sulfate (mg/L)	Phos-phorous as P (mg/L)
WELL 3A(OUT)	01	C832517	07/16/83	7.9	313	< 0.03	55	1.6	110	380	564	940	61	101	<0.02
WELL 3B(OUT)	02	C833462	09/11/83					20.5							
WELL 3B(OUT)	02	C832518	07/16/83	7.7	307	< 0.03	20	7.7	102	370	575	930	61	106	<0.02
WELL #2	03	C895936	08/29/89	8	485	0.28	120	12	43	642	1180	1919	210	280	0.02
WELL #2	03	C882345	05/03/88											250	
WELL #2	03	C842985	08/02/84					15							
WELL #2	03	C842986	07/24/84					10							
WELL #2	03	C841873	06/01/84					15							
WELL #2	03	C841769	05/28/84					25							
WELL #2	03	C841656	05/16/84					8							
WELL #2	03	C840932	03/20/84	7.9	420	2.33	80	65.3	34	520	914	1650	178	222	0.01
WELL #2	03	C811132	03/19/81	8.1	407	0.37	45	0.8	92	490	854	1410	88	188	0.06
CAVE SPRINGS	04	C909115	09/20/99												
CAVE SPRINGS	04	C992670	04/12/99												
CAVE SPRINGS	04	C976353	07/07/97												
CAVE SPRINGS	04	C968758	09/24/96												
CAVE SPRINGS	04	C959266	08/28/95		198	0.54	40	1.5	55	240	326	565	33	54	0.02
CAVE SPRINGS	04	C946102	06/20/94												
CAVE SPRINGS	04	C930572	10/18/93											46	
CAVE SPRINGS	04	C933070	04/27/93												
CAVE SPRINGS	04	x362691	11/13/90			0.38	0.1		60						
Recommended Limit :						**0.3**	**50**	**5.0**		**400**	**500**		**250**	**250**	